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OCULOPLASTIC SURGERY

By

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I dedicate my thesis to the memory of my father, Samuel F. Perone Jr., who gave me the opportunity to work with the physicians at Wills Eye Hospital in Philadelphia, and for his support and confidence, which gave me the strength to finish.

PURPOSE

The purpose of my thesis was to create a teaching aid for medical resident students pursuing ophthalmology. The CD contains present research, medical information, and surgical information in the field of oculoplastics. Oculoplastics is a field of ophthalmology that includes complications of the eye, orbit, and lacrimal system. Oculoplastic cases can range from cosmetic and reconstructive surgery, lacrimal blockage, to eye removal for preparation of prostheses (artificial eyes). The CD includes six procedures that are common in oculoplastic surgery.

INTRODUCTION

In the medical world the amount of information that doctors need to know is overwhelming and it keeps expanding every day. Advances in medical research make keeping up to date with the latest procedures an arduous process. My thesis caters to these new needs by developing a way of presenting some of the most contemporary operative procedures in the field of oculoplastics. The information contained in this CD is compacted and accurately presented so that the residents in this field can access it effortlessly. I decided to create an interactive CD containing narration and animation to simplify the understanding of some common surgical procedures.

Technology has reformed our understanding of the human body. With the advent of digital image technology, the interior of the body, once concealed from sight, can be explored. Computer software has taken the form of the body and launched it into the digital platform. Interactive software, especially virtual reality, has taken technology even further by applying it to virtual operations. This technology is used to train surgeons to operate in a simulated environment instead of practicing on humans.

These new software technologies will change the biomedical profession and make information more readily available to the medical and global community. They will expand education and improve teaching. These new tools will have the power to inform and will make dominant advances in Internet and virtual reality software for education. The traditional methods will be obsolete compared to the effectiveness of these new ones. Speed, accuracy and availability will be the major contributing factors in the development of new teaching aids for the expanding medical community.

We live now in a society that is constantly bombarding us with information on a daily basis, feeding us information rashly. There has been a constant speeding up of the inertia of society since the beginning of the human race, but only within the last century has technology progressed so rapidly, from the plane to telecommunications, it just keeps getting faster.

Everyone has an increased sense of learning through the visual process, because not everyone can read and remember by text alone. Observing virtual surgery through digital technology is not new, and it is just a matter of time before it becomes a standard interactive method and an aid to teaching.

PROBLEMS OF THE ORBIT AND PERIORBITAL AREA

Oculoplastics is a field of ophthalmology that deals with complications of the eye, orbit, and lacrimal system. Oculoplastic cases can range from cosmetic and reconstructive surgery, lacrimal blockage, to eye removal for preparation of prostheses (artificial eyes). The pathological conditions described below are corrected through the surgical procedures illustrated in my CD, "Oculoplastic Surgery".

Epiblepharon is defined as the inversion or turning in of the upper and lower lid margin. Operative procedures described to correct an epiblepharon include horizontal shortening of the tarsal plate, tightening of the orbital septum, repositioning the orbicularis muscle, and the excision of excess skin and muscle. The procedure demonstrated in my CD is titled "Lower eyelid crease reformation for epiblepharon correction."

Ectropion is defined as eversion and downward pull of the lower eyelid, causing the lid margin to fall away from the globe, where it usually rests. Correction is achieved by a medial, superior shift of the lower punctum, with the upper lid sliding behind the medial portion of the lower lid. The procedure demonstrated in my CD is titled "Ectropion repair by lateral tarsal strip fixation."

Ptosis defined as an abnormally low position of the upper eyelid margin when the ipslateral globe is directed in primary gaze. Current techniques of ptosis repair generally involve frontalis suspension, anterior levator resection/reattachment, or posterior conjunctival Muller's muscle resection. The procedure demonstrated in my CD is titled "External levator aponeurosis advancement or repair."

DCR (Dacryocystorhinostomy) is a common congenital lacrimal problem that involves blockages of the Nasolacrimal Duct disrupting the flow of tears. The aim of this procedure is to create a drainage pathway, bypassing the site of obstruction. The procedure demonstrated in my CD is titled "Dacryocystorhinostomy."

Enucleation is the surgical removal of the globe and a portion of the optic nerve from the orbit. The specific indications for Enucleation include primary intraocular malignancies, irreparable trauma, and blind, painful eyes unrelieved by medical management, and cosmetic repair. An aloplastic implant is placed in the muscle cone once the globe is removed. The alopastic implant is a mold for the eye socket in preparation for prosthesis. The procedure demonstrated in my CD is titled "Enucleation with primary aloplastic ocular implant."

Evisceration is the removal of the contents of the globe, while leaving the sclera and the optic nerve intact. The procedure demonstrated in my CD is titled "Evisceration."

PRODUCTION

The construction of my thesis was done in specific individual steps. The first step was to create six separate animations using Director 7.0. After the animations were completed containing the surgical procedures, they then were hosted by one movie that provided the navigation. The following will give a detailed overview from the beginning of production through to the end.

I spent a summer conducting research at Wills Eye Hospital, Philadelphia, observing surgical procedures under the guidance of Marlon Maus, M.D. Co-director of Resident Education. I observed oculoplastic surgery on a daily basis that included dacryocystorhinostomy, enucleation, evisceration, ptosis, ectropion, and entropion. During my surgical observations, I produced a large number of reference sketches and gained a good understanding of each surgical procedure. All of the images and animations in my CD are based on sketches from these surgical observations.

I started by redrawing previous sketches of the eye area using different views and angles that would be most appropriate for displaying the surgical steps in the interactive CD. I decided to use an anterior view focusing on the left eye, socket and eyelid. The composition allowed enough space above and below to crop or expand the final view. Using photographs as references, I scaled the eye larger than normal to show a closer view of the procedure. Through PhotoShop, I imported sketches and drawings of other parts of the operations. This included opened and closed hands holding surgical instruments. I also rendered a patient, under anesthesia, prepped on the operating table, viewed from the neck up, and covered in surgical drape. This drawing was to be used for the cover layout and introduction. I used colored pencils on Canson paper to do all the finished artwork except for the images of instruments, which I made directly in PhotoShop. The remaining images were then scanned into PhotoShop and prepared with some color adjustment. Research in Miner Library at the University of Rochester School of Medicine, and consultation with Dr. Maus, gave a precise cast of instruments, views and backgrounds.

After importing the various images into PhotoShop, I began to formulate an outline of the steps used in each operation. I referred back to, and organized most of the procedures from, my operative sketchbook. I started plotting the basic surgical steps, producing five to eight steps for each procedure. PhotoShop airbrush tool and masks helped me assemble the different layers of tissues to be removed or sewn back together during each one of these procedures. Once the basic construction was laid out, I printed the images and constructed them into a book to give to Dr. Maus. After his review, I made the necessary changes. He included the correct suture techniques and provided a narration of the steps used when performing these operations. The changes were made and the next step was to construct the interactive interface to run these surgeries.

The layout was created in Director 7.0. The navigational scripting, text, rollovers and appearance were all considered in the actual functioning of the movies. The layout begins with an introduction showing the patient along with the title. In the bottom left hand corner is a round button that advances you into the main page. The main page consists of the titles of each operation. The titles of the buttons read as follows: “Dacryocystorhinostomy”, “Enucleation”, “Evisceration”, “Ptosis”, “Ectropion”, and “Epiblepharon”. These buttons react when the cursor enters them by changing to italic and white letters. Once the mouse button is clicked, it advances to the specific operation. The interactivity allows the viewer to stop or advance the animation through each operation.

Organization of the functioning animation was next. The rationale when constructing the thesis was to make the narration the most important overall function determining the progression of the animation. The narration provided by Dr. Maus was brought into Sound Edit 16 and broken apart so each surgical step was a separate sound file. I imported the sound files into Director 7.0, and used a sound puppet function to activate the sound when needed. As I was producing this CD, I discovered that I was learning these surgeries. My personal goal was to make them accurate and easy to understand visually so that anyone with basic training in anatomy could easily follow the steps.

The animations were the last function to complete. The animations were initially to only describe the important aspects of the specific surgeries, but over the course of time they expanded to include almost every step of the surgery. The animated surgeries give an outline of the procedure for the resident to follow that includes the correct instruments and gives the viewer a clear representation of the procedure. When the finished product is run, it illustrates how the surgery takes place.

OPERATIVE PROCEDURES

The following are transcriptions of the narrations provided for the corrective surgical procedures found in the interactive CD, "Oculoplastic Surgery".

Dacryocystorhinostomy

After injection of local anesthetic to the medial canthal area, and packing the nose with cocaine soaked pledgets, an incision is made in the medial canthus using a 15 blade. Adequate hemostatis is obtained using bipolar cautery. Dissection is carried down to the periosteum anterior to the lacrimal sac using Steven's scissors or Westcott scissors. The marginal artery and vein are present at this position and should be avoided if possible. After the periosteum is incised using a 15 blade, the periosteum is elevated into the lacrimal fossa. The lacrimal sac is then gently elevated from the bone underlying the area. The bone can be easily penetrated using a bone rongeur such as a Kerrison punch. The bone is then removed piecemeal until the entire area of the lacrimal sac is completely open into the nose. The number 1 or number 0 Bowman probe is placed within the canalicular system into the lacrimal sac. The lacrimal sac is then gently tented upward and opened using a number 11 surgical blade. An anterior and posterior flap is created using Westcott scissors, both in the lacrimal sac and in the nasal mucosa. Usually, the posterior lacrimal sac flap is sent for histopathologic diagnosis. At the same time the posterior flap of the nasal mucosa should also be removed. If intubation is to be carried out using silicone stents, they are placed at this time within the upper and lower canalicular systems and passed into the nose where they are tied on a silicone sponge. The anterior flaps of the lacrimal sac and the nasal mucosa are sutured using a 5.0-vycril suture on a p2 needle. The overlying skin and muscle of the incision are now closed using multiple interrupted 6.0 plain sutures.

Ectropion repair by lateral tarsal strip fixation

After injection of local anesthetic to the lateral canthal area, a lateral canthotomy is made using Westcott scissors. The inferior lateral canthal tendon is then cut using Westcott scissors. Adequate hemostatis is obtained using bipolar cautery. A small amount of anterior lamella is removed using Westcott scissors. The upper border of the margin of the lid is then removed. The conjunctiva of the tarsal strip is taken off using a 15 blade. Approximately five to eight millimeters of tarsal strip should be created depending on the laxity of the lid. The tarsal strip is then reattached to the lateral superior interior orbital rim using a 4.0 or 5.0 vycril suture on a p2 needle. The length of the tarsal strip depends on the laxity of the lid in the preoperative examination. Any excess skin can be removed at this time from the lateral incision. The lateral angle is then recreated using a buried 6.0 plain suture. 6.0 plain sutures are used to close the skin and muscle.

Enucleation with primary alloplastic ocular implant

A retrobulbar injection of local anesthetic with epinephrine is given before the surgery begins. A 360-degree peritomy is created using Westcott scissors. Adequate hemostatis throughout the procedure is obtained using bipolar cautery. The four quadrants are isolated using Steven's tenotomy scissors. Using a muscle hook, the four rectus muscles are hooked and sutured using a 5.0 vycril suture on a spatulan needle. The suture should be passed near the insertion of the muscle, leaving a small stump on the globe. The suture should be carefully locked onto the muscle to prevent slippage. The muscle is cut from its insertion to the globe using Westcott scissors. Curved enculeation scissors are gently inserted medially down to the optic nerve. The optic nerve is then felt by moving the scissors up and down, twanging the nerve. The optic nerve is cut several millimeters behind the globe. This is particularly important if the enculeation is being carried out for an intraocular malignancy. As the globe is being removed, the oblique muscles will have to be cut using Steven's tenotomy scissors. An aloplastic implant, usually 18 to 20 millimeters in diameter, is placed within the muscle cone. Great care is taken to be certain that Tenon's capsule is placed over the implant. The rectus muscles are sutured over the implant using the pre-placed vycril sutures.

The superior rectus muscle is sutured to the inferior rectus muscle and the medial rectus muscle to the lateral rectus muscles. Tenon's capsule is closed using multiple interruped 5.0 vycril sutures. Great care is taken to make certain that tenon's capsule is completely closed over the implant. The conjunctiva is then closed using a running 6.0 plain suture. A conformer is placed and a pressure patch applied which is kept for several days post-operatively. Healing is usually complete after four to six weeks at which time it is safe to place prosthesis within the socket.

Lower eyelid crease reformation for epiblepharon correction

A sterile marking pen is used to mark the extent of skin and muscle to be removed in the area of the epiblepharon. The superior border of the incision should be made in the subciliary area. Local anesthetic is injected in the area using a 27 gauge needle. An incision is made in the subciliary area using a 15 blade. Adequate hemostatis is obtained using bipolar cautery. The elipse of skin and muscle are removed using Westcott scissors. Closure of the incision is accomplished using a running 6.0 plain suture.

Evisceration

After injection of local anesthetic with epinephrine is given to the retrobulbar area, a 360-degree peritomy is created using Westcott scissors. Adequate hemostatis is obtained using bipolar cautery. An 11 blade is inserted approximately 3 to 4 millimeters beyond the corneal limbus. An evisceration spatula is inserted between the sclera and the retina. The entire contents of the globe are then removed, including the cornea, and sent for histopathologic diagnosis. Adequate hemostatis is obtained using bipolar cautery. The scleral shell is then carefully cleaned, using Q-tips soaked in hydrogen peroxide. Four relaxing incisions are made between the rectus muscles using Steven's tenotomy scissors. The length of the incision should be approximately equal to the equator of the globe. A fourteen to sixteen millimeter sphere is placed within the sclera. The inferior and superior flaps are then sutured using multiple interrupted 5.0 vycril sutures. The same is done for the medial and lateral flaps. Any redundant sclera can be removed at this time. The conjunctiva is closed using a running 6.0 plain suture. A conformer is placed within the socket and a pressure patch applied. Healing is complete usually within four to six weeks at which time a prosthesis can be placed safely in the socket.

External levator aponeurosis advancement or repair

After injection of local anesthetic to the upper lid, a sterile marking pen is used to mark the lid crease where the incision is to be made. A section of skin and muscle are then marked which will be removed during the surgery. An incision is made using a 15 blade. Adequate hemostatis is obtained using bipolar cautery. The ellipse of skin and muscle that were previously marked are removed using Westcott scissors. Dissection is carried down to the pre-aponeurotic fatpad. This is noted by the covering of septum. It is gently released from the levator, which is underneath the fat. It will be noted that the levator aponeurosis is usually dehisced from its attachment to the tarsus. The aponeurosis is then reattached to the superior border of the tarsus, using multiple interrupted 5.0 vycril sutures. Using a double arm suture and a slipknot, it is possible to adjust the level of the lid by moving the suture further up or down depending on the position of the lid. The position of the lid should be checked many times during the procedure to be certain that the contour and height are appropriate. Anywhere between one and three sutures are placed to attach the aponeurosis to the tarsus. Skin and muscle are then closed using a running 6.0-plain suture which is imbricated in several places to recreate the lid crease.

CONCLUSION

In conclusion, I feel the success of the interactive CD comes from the accuracy of the animations used to describe the surgical procedures found in this CD. I now have a working prototype that can be improved and expanded. I feel the amount of work and effort I put into it is reflected in the finished product.

If given sufficient time to address the interactive aspects of this CD I believe production could have been improved tremendously. This prototype is a preview of how new technology and software can be used to change the shape of education and teaching.

I believe that the future advances that will be made in this new field will extraordinary. Major corporations have already established a presence in the future of this field by creating virtual reality and 3D environments making surgical simulators more accurate and real. There are also advancements being made in the production of computer-controlled robots to perform routine surgeries. The future of medicine will become more technological resourceful and beneficial and will continuous improve the health care of humans.

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